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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/784,947	02/25/2004	Masahiro Totsuka	402986	8433
23548	7590	12/08/2005		
LEYDIG VOIT & MAYER, LTD 700 THIRTEENTH ST. NW SUITE 300 WASHINGTON, DC 20005-3960			EXAMINER AU, BAC H	
			ART UNIT 2822	PAPER NUMBER

DATE MAILED: 12/08/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/784,947

Applicant(s)

TOTSUKA ET AL.

Examiner

Bac H. Au

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**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --****Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 4 November 2005.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-7 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,2,4,6 and 7 is/are rejected.
- 7) ☒ Claim(s) 3 and 5 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 25 February 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \*    c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

## **DETAILED ACTION**

### ***Response to Amendment***

1. Applicant's amendment dated November 4, 2005 in which claims 2, 6, and 7 were amended has been entered.

### ***Priority***

2. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file. Furthermore, receipt is acknowledged of the certified English language translation of the priority patent application in perfecting the priority claim.

### ***Claim Rejections - 35 USC § 112***

3. Rejection of claims 2 and 7 under 35 U.S.C. 112, second paragraph, are withdrawn.

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless -

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1, 2 and 4 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Applicant's admitted prior art in view of Spruytte et al. (MBE Growth of Nitride-Arsenide Materials for Long Wavelength Optoelectronics). Applicant teaches in the specification, page 1 line 17 to page 2 line 3, a method of manufacturing a device comprising:

preparing a substrate having a surface that is a gallium nitride related material ("a field effect transistor in which gallium nitride (GaN) is used as the material of the substrate");

decomposing a nitrogen-containing gas in a catalytic reaction to produce atomic nitrogen ("the substrate is treated with a plasma of N<sub>2</sub>, NH<sub>3</sub> or the like");

contacting the surface with the atomic nitrogen to nitride the surface ("the surface of the gallium nitride substrate are replace by nitrogen atoms (which is called nitriding)");  
and

forming, on the surface, a gate electrode and source and drain electrodes on opposite sides of the gate electrode ("a field effect transistor").

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The admitted prior art does not expressly state that the plasma treatment is a “catalytic reaction.” However, the energy, typically a radio frequency energy, inherent in a plasma process is an “agent that provokes or speeds significant change or action” and thus anticipates the limitation (see definition of ‘catalyst’ from *Merriam Webster’s Collegiate Dictionary*, 10<sup>th</sup> edition). Furthermore, the admitted art does not expressly state that the reaction will produce atomic nitrogen. However, atomic nitrogen is considered either inherent in the plasma process of the prior art, or made obvious as motivated by Spruytte et al.

Spruytte et al., as well as the references to Vaudo et al. and Blant et al., teach that atomic nitrogen is produced as part of a nitrogen plasma process. Specifically, Spruytte et al. teach under the heading *Details of MBE Nitride-Arsenide Growth* (2<sup>nd</sup> para., 1<sup>st</sup> sentence) that “an rf plasma is used to generate atomic nitrogen.” Similarly, Vaudo et al. show in figures 1 and 2 that atomic nitrogen is produced in a radio frequency plasma as evidenced by the emission spectrum in the near-IR range. And Blant et al. teach, in the penultimate paragraph in the second column of the first page, that an “RF source [used as a plasma source] produces much more neutral atomic nitrogen.” As such, Spruytte et al., as well as Vaudo et al. and Blant et al. teach that a plasma reaction will inherently produce atomic nitrogen.

And even if it is assumed *arguendo* that atomic nitrogen is not produced, it is considered obvious to combine the admitted prior art with the Spruytte et al. Spruytte et al. teach that an rf plasma is used to generate atomic nitrogen and motivate its use in that it minimizes ion damage to the surface of the growing film (a GaN based film). The

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admitted prior art and Spruytte et al. are combinable because they are from the same field of endeavor. Therefore, it would have been obvious to combine the admitted prior art and Spruytte et al. to obtain the invention of claims 1, 2 and 4.

Regarding claim 4, applicant's prior art discloses a method of manufacturing a semiconductor device including a gallium nitride related semiconductor material, the method comprising:

- preparing a substrate having a surface that is gallium nitride related semiconductor material;

- forming, on the surface, a gate electrode and source and drain electrodes on opposite sides of the gate electrode;

- decomposing a nitrogen-containing gas in a catalytic reaction to produce atomic nitrogen;

- contacting the surface, at an area between the source electrode and the gate electrode and at an area between the drain electrode and the gate electrode, with the atomic nitrogen, to nitride the surface.

5. Claims 6 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's admitted prior art in view of Nguyen (U.S. Pat. 5766695).

Regarding claims 6 and 7, Applicant's prior art discloses a method of manufacturing a semiconductor device including a gallium nitride related semiconductor material, the method comprising:

preparing a substrate having a surface that is gallium nitride related semiconductor material;

forming, on the surface, a gate electrode and source and drain electrodes on opposite sides of the gate;

decomposing a nitrogen-containing gas in a catalytic reaction to produce atomic nitrogen;

contacting the surface, at an area between the source electrode and the gate electrode and at an area between the drain electrode and the gate electrode, with the atomic nitrogen, nitriding the surface.

Applicant's prior art fails to disclose forming one of an insulating film and an aluminum film covering all of the surface and having a thickness in a range of 10 to 50 Angstroms;

wherein, in the nitriding, the atomic nitrogen passes through the insulating or aluminum film and contacts the surface so the surface is nitrided.

However, Nguyen [Fig 4, column 4, lines 48-64] discloses depositing an insulating layer and nitriding the surface through an insulating or "dummy layer" by ion implantation and varying the thickness of the "dummy layer" [Nguyen teaches in col.4,

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lines 54-58; col. 5, line 59 – col.6, line 3, that the relationship between dummy layer thickness and implantation energy is well-known in the art. Having an insulating layer thickness of 10 to 50 Angstroms just means that the implantation energy is adjusted accordingly. Having the narrow range in thickness is merely an optimization, and as such is not patentable. See *In re Huang*, 40 USPQ2d 1685 (Fed. Cir. 1999)] to obtain greater reduction in defects on the surface layer.

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Nguyen into the Applicant's prior art to nitride the surface of the gallium nitride related semiconductor material through an insulating or aluminum film by ion implantation. The ordinary artisan would have been motivated to modify Applicant's prior art in the manner set forth above for at least the purpose of improving the controllability of the nitriding process as well as preventing the nitrogen from escaping from the surface layer during subsequent high temperature processing steps [Nguyen, column 5, lines 11-19].

#### ***Allowable Subject Matter***

6. Claims 3 and 5 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

#### ***Response to Arguments***



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7. Applicant's arguments have been considered but are moot in view of the new ground(s) of rejection.


**Conclusion**

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Bac H. Au whose telephone number is 571-272-8795. The examiner can normally be reached on Mon-Fri 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on 571-272-1852. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

BHA

  
GEORGE ECKERT  
PRIMARY EXAMINER